

APPENDIX A

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```

/* ***** LBUCKET.C *****
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* OLICOM Software License Agreement which restricts the manner
* in which it may be used.
*
* -----
* Description: Leaky bucket routines
* -----
*
* $Log: lbucket.c,v $
* Revision 1.3 1998/06/15 12:31:45 cto
* CreditLeft now returns sdword rather than sword
*
* Revision 1.2 1998/06/15 11:25:14 cto
* Modifications for process overload buckets.
* Function UseLeakyBucketAfter added.
*
* Revision 1.1 1998/06/04 10:43:06 cto
* Addition of leaky bucket files lbucket.c, lbucket.h
*
* -----
*/
static char _V[] = "-e(%)lbucket.c $Revision: 1.3 $";
static char _V_align(4-sizeof(_V)*4) = (0*sizeof(_V_align));

/* ***** DESIGN DESCRIPTION ***** */
/* *****
*
* This file provides a general-purpose leaky bucket mechanism that can be
* used, for example, to limit the number of events that are handled by a
* particular process. A leaky bucket is an abstract object that is not
* directly associated with a queue or any other object in the system.
*
* The leaky bucket descriptor (of type t_leaky_bucket) is typically allocated
* as module-local data.
*
* Every leaky bucket has a fill level. When a user uses the bucket, a value
* is added to the fill level. Every t microseconds, the value c is subtracted
* from the fill level; however, the fill level is never allowed to fall below
* zero. The value t may only take on a fixed set of values, corresponding to
* the timer hooks available in the system. Typically, these values are 20 ms,
* 50 ms, 100 ms, 1 s, 5 s, 1 minute, 1 hour, and 1 day; however, 1 day
* corresponds to 86,400,000,000 us, which cannot be stored in a dword.
*
* The bucket size m is the maximum allowed fill level in the bucket.
*
* The difference between the maximum fill level and the current fill level is
* called the 'credit'.
*
*/

/* ***** TABLE OF CONTENTS ***** */
/* *****
*
* Callback function for draining the bucket:
* DrainLeakyBucket
*
* API functions:
* CreateLeakyBucket
* CreditLeft
* DestroyLeakyBucket
* ModifyLeakyBucket
* UseLeakyBucket
* UseLeakyBucketAfter
*
*/

```

```

/*****
/*                                INCLUDE FILES                                */
*****/

#include    "h_define.h"
#include    INCL_OLCOS_H
#include    "lbucket.h" /*INCL_LBUCKET_H*/
#include    INCL_HOOKS_H

/*****
/*                                PRIVATE TYPES and DEFINITIONS                    */
*****/

/*****
/*                                PRIVATE DATA                                */
*****/

/* TBD: This must be declared elsewhere: */

extern t_hook_event timer_20ms_hooks;
extern t_hook_event timer_50ms_hooks;
extern t_hook_event timer_100ms_hooks;
extern t_hook_event timer_1sec_hooks;
extern t_hook_event timer_5sec_hooks;
extern t_hook_event timer_1min_hooks;
extern t_hook_event timer_1hour_hooks;
extern t_hook_event timer_1day_hooks;

/* TBD: This must be moved to custom.c: */

t_timer_hooks aTimerHooks[] = {
    { &timer_20ms_hooks,      200000UL },
    { &timer_50ms_hooks,      500000UL },
    { &timer_100ms_hooks,     1000000UL },
    { &timer_1sec_hooks,      1000000UL },
    { &timer_5sec_hooks,      5000000UL },
    { &timer_1min_hooks,      60000000UL },
    { &timer_1hour_hooks,     3600000000UL },
    { NULL, 0 }
};

/*****
/*                                EXPORTED DATA                                */
*****/

/*****
/*                                PRIVATE FUNCTIONS                                */
*****/

/*===== DrainLeakyBucket =====
** Function called by the hook mechanism to drain the bucket
**-----*/
STATIC void          /*RET Nothing */
DrainLeakyBucket(
dword bucket)        /*IN Address of leaky bucket */
{
    t_leaky_bucket_request *pEvReq;
    t_leaky_bucket *pBucket = (t_leaky_bucket*)bucket;

    critical_on();

    if (pBucket->currentLevel < pBucket->drainAmount)
        pBucket->currentLevel = 0;
    else
        pBucket->currentLevel -= pBucket->drainAmount;

    /* Is somebody waiting that now has sufficient credit */
    while ((pEvReq = (t_leaky_bucket_request*)queue_peek(&pBucket->evQ)) != NULL) {
        dword realMax = pEvReq->maxi == 0 ? pBucket->maxLevel : pEvReq->maxi;

        /* Is there now credit enough to service this request? */
        if (realMax >= pBucket->currentLevel + pEvReq->amount) {
            /* We have enough credit */
            pBucket->currentLevel += pEvReq->amount;

            (void)queue_get(&pBucket->evQ); /* Remove pEvReq from queue... */
            request_start(&pEvReq->event_head); /* ...and send it */
        }
    }
}

```



```

t_timer_hooks *pth;
dword oldMaxLevel;
t_leaky_bucket_request *pevReq;

ASSERT(pBucket->hook!=NULL, pBucket); /* Primitive test that bucket is in use */

/* Find a timer hook that can handle the time t */
for (pth=aTimerHooks; pth->hook: pth++)
    if (pth->microsec==t) break;

if (!pth->hook) /* We didn't find a hook */
    return CC_RANGE_ERROR;

critical_on();

/* Reinitialize the bucket, but don't touch currentLevel */
oldMaxLevel = pBucket->maxLevel;
pBucket->drainAmount = c;
pBucket->drainTime = t;
pBucket->maxLevel = m;

/* Set up the timer hook to handle the bucket */
clear_hook(&pBucket->hook);
pBucket->hook = set_hook(pth->hook, DrainLeakyBucket, (dword)pBucket);

/* If the maxLevel increased, we may now be able to service some waiting events */
if (m > oldMaxLevel) {
    while ((pevReq = (t_leaky_bucket_request*)queue_peek(&pBucket->evq))!=NULL) {
        dword realMax = pevReq->maxi==0 ? pBucket->maxLevel : pevReq->maxi;

        /* Is there now credit enough to service this request? */
        if (realMax >= pBucket->currentLevel + pevReq->amount) {
            /* We have enough credit */
            pBucket->currentLevel += pevReq->amount;

            (void)queue_get(&pBucket->evq); /* Remove pevReq from queue... */
            request_start(&pevReq->event_head); /* ...and send it */
        }
        else
            break;
    }

    critical_off();

    return CC_OK;
}

/*===== UseLeakyBucket =====
** UseBucket increments the fill level on the specified leaky bucket by the
** specified amount. It returns TRUE if the fill level can be incremented
** without the bucket overflowing. If the available credit is less than amount
** or if somebody else is waiting for the bucket to drain, the fill level is
** not incremented and the function returns FALSE.
**
** If the argument maxi is greater than 0, it specifies a fill level maximum
** to be used instead of the value specified when the bucket was created.
**
** The argument pevReq may be NULL or the address of a user-defined event. If
** it is not NULL, it is assumed to be the address of an event. In this case
** the event will be returned to the calling process when the desired credit
** is available. When the event is returned, the fill level has already been
** incremented by the desired amount.
**=====*/
bool
UseLeakyBucket(
    t_leaky_bucket *pBucket, /*IN Address of leaky bucket descriptor */
    dword amount, /*IN Usage amount */
    dword maxi, /*IN Alternative maximum (or 0 for default) */
    t_leaky_bucket_request *pevReq) /*IN Leaky bucket request event */
{
    dword realMax;

    ASSERT(pBucket->hook!=NULL, pBucket); /* Primitive test that bucket is in use */

    critical_on();

    realMax = maxi==0 ? pBucket->maxLevel : maxi;

    /* Test if the bucket will overflow or if somebody is already
       waiting for the bucket */

```

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if (realMax >= pBucket->currentLevel + amount && queue_empty(&pBucket->evQ)) {
    /* No overflow and nobody waiting */
    pBucket->currentLevel += amount;

    critical_off();
    return TRUE;
}

/* Overflow or somebody waiting */
if (pEvReq) {
    pEvReq->amount = amount;
    pEvReq->maxi = maxi;
    queue_put(&pBucket->evQ, &pEvReq->event_head.resource_head);
}

critical_off();
return FALSE;
}

/*===== UseLeakyBucketAfter =====
** This is a special version of UseLeakyBucket. It is called _after_ the
** resource it monitors has been used. Therefore it never fails, but it does
** return an indication of whether an overflow occurred or not.
**
** This function is primarily intended to be used with process overflow
** detection.
**-----*/
bool
UseLeakyBucketAfter(
    t_leaky_bucket *pBucket,    /*IN Address of leaky bucket descriptor */
    dword amount,              /*IN Usage amount */
    dword maxi)                /*IN Alternative maximum (or 0 for default) */
{
    dword realMax;
    bool bNoOverflow;

    ASSERT(pBucket->hook!=NULL, pBucket); /* Primitive test that bucket is in use */

    critical_on();

    realMax = maxi==0 ? pBucket->maxLevel : maxi;
    pBucket->currentLevel += amount;
    bNoOverflow = (realMax >= pBucket->currentLevel);

    critical_off();
    return bNoOverflow;
}

```

```
#undef INCL_LBUCKET_H
#define INCL_LBUCKET_H "empty.h"
```

```
/*
***** LBUCKET.H *****

```

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```

```
Description: Leaky bucket definitions
```

```
Slog: lbucket.h.v 5
Revision 1.3 1998/06/15 12:31:59 cto
CreditLeft now returns sdword rather than sword
Revision 1.2 1998/06/15 11:23:15 cto
Added function UseLeakyBucketAfter
Revision 1.1 1998/06/04 10:43:06 cto
Addition of leaky bucket files lbucket.c, lbucket.h
```

```
/*
* @(#)lbucket.h $Revision: 1.3 $ */
```

```
*****
* INCLUDE FILES
*****
```

```
#include INCL_HOOKS_H
```

```
*****
* EXPORTED TYPES and DEFINITIONS
*****
```

```
/* t_timer_hooks represents a relationship between a timer hook and the time
interval it represents.
```

```
typedef struct timer_hooks {
    t_hook_event *hook; /* The hook */
    dword microsec; /* The corresponding time in us */
} t_timer_hooks;
```

```
/* The file custom.c must implement the array aTimerHooks, which contains the
mapping between timer values and the corresponding timer hook addresses.
The last entry must have hook=NULL.
```

```
extern t_timer_hooks aTimerHooks[];
```

```
/* t_leaky_bucket_request is an event type that is used when a process
requests notification when credit becomes available.
```

```
typedef struct leaky_bucket_request {
    t_event_head event_head; /* Standard event structure */
    dword amount; /* Requested credit */
    dword maxi; /* Maximum fill level */
} t_leaky_bucket_request;
```

```
/* t_leaky_bucket is the leaky bucket descriptor */
```

```
typedef struct leaky_bucket {
    t_hook *hook; /* Timer hook handling this bucket */
    dword drainAmount; /* Drain amount every t us */
    dword drainTime; /* Time in us between drains */
    dword maxLevel; /* Fill level maximum */
    dword currentLevel; /* Current fill level */
}
```

```

t_queue_head evq;          /* Queue of events that are to be sent when
                             there is room in the bucket */
t_process *pProcess;        /* Address of process for which this bucket
                             is an overload bucket. This field is
                             NULL if this is not an overload bucket. */
) t_leaky_bucket;

/***** EXPORTED DATA *****/
/*
**** EXPORTED FUNCTIONS *****/

/***** CreateLeakyBucket *****/
/* Create a leaky bucket.
** The argument t must correspond to one of the timer hooks configured
** in the system.
*/
t_return
CreateLeakyBucket(
    t_leaky_bucket *pBucket,    /*IN Address of leaky bucket descriptor */
    dword c,                   /*IN Drain amount every t us */
    dword m,                   /*IN Fill level maximum */
    dword t);                  /*IN Time in us between drains */

/***** CreditLeft *****/
/* Returns the amount of credit left in the bucket
*/
dword
CreditLeft(
    t_leaky_bucket *pBucket);   /*IN Address of leaky bucket descriptor */

/***** DestroyLeakyBucket *****/
/* DestroyLeakyBucket prevents the timer from further decrementing the fill
** level. After this function has been called, there will be no external
** references to the leaky bucket, and the de-scriptor may be deallocated.
*/
void
DestroyLeakyBucket(
    t_leaky_bucket *pBucket);   /*IN Address of leaky bucket descriptor */

/***** ModifyLeakyBucket *****/
/* Modifies the parameters of an existing leaky bucket. The current fill level
** in the bucket will be left untouched, even if it is greater than m.
*/
t_return
ModifyLeakyBucket(
    t_leaky_bucket *pBucket,    /*IN Address of leaky bucket descriptor */
    dword c,                   /*IN Drain amount every t us */
    dword m,                   /*IN Fill level maximum */
    dword t);                  /*IN Time in us between drains */

/***** UseLeakyBucket *****/
/* UseBucket increments the fill level on the specified leaky bucket by the
** specified amount. It returns TRUE if the fill level can be incremented
** without the bucket overflowing. If the available credit is less than amount
** or if somebody else is waiting for the bucket to drain, the fill level is
** not incremented and the function returns FALSE.
**
** If the argument maxi is greater than 0, it specifies a fill level maximum
** to be used instead of the value specified when the bucket was created.
**
** The argument pevReq may be NULL or the address of a user-defined event. If
** it is not NULL, it is assumed to be the address of an event. In this case
** the event will be returned to the calling process when the desired credit
** is available. When the event is returned, the fill level has already been
** incremented by the desired amount.
*/
bool
UseLeakyBucket(
    t_leaky_bucket *pBucket,    /*IN Address of leaky bucket descriptor */
    dword amount,              /*IN Usage amount */
    dword maxi);               /*IN Alternative maximum (or 0 for default) */

```

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```
t_leaky_bucket_request *pvrReq); /* IN Leaky bucket request event */
```

```
/*===== UseLeakyBucketAfter =====  
** This is a special version of UseLeakyBucket. It is called after the  
** resource it monitors has been used. Therefore it never fails, but it does  
** return an indication of whether an overflow occurred or not.  
**  
** This function is primarily intended to be used with process overflow  
** detection.  
*/  
bool /* RET Success? */  
UseLeakyBucketAfter(  
t_leaky_bucket *pBucket, /* IN Address of leaky bucket descriptor */  
dword amount, /* IN Usage amount */  
dword maxi); /* IN Alternative maximum (or 0 for default) */
```


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